

What is claimed is:

- 1                   1.     A system comprising:  
2                   a plurality of data centers, including a first data center and a second data  
3 center, each data center comprising:  
4                   a storage system; and  
5                   a host server;  
6                   a directory server;  
7                   at least one of a plurality of access gateways;  
8                   a network interconnecting said plurality of data centers, said directory  
9 server, and said access gateway; wherein  
10                  responsive to input received via any of said at least one of a plurality of  
11 access gateways, any of said plurality of data centers may be configured as a primary  
12 (source) of data, and any of said plurality of data centers may be configured as a  
13 secondary (target) of data in a copy operation.
- 1                   2.     The system of claim 1, wherein, responsive to said input received  
2 via any of said at least one of a plurality of access gateways, information about said first  
3 data center and said second data center is fetched from said directory server, and  
4 thereupon, said first data center may be configured as a primary (source) of data, and said  
5 second data center may be configured as a secondary (target) of data in a copy operation.
- 1                   3.     The system of claim 2, wherein, responsive to a second input  
2 received via any of said at least one of a plurality of access gateways, said first data center  
3 may be reconfigured as a secondary (target) of data, and said second data center may be  
4 configured as a primary (source) of data in a second copy operation.
- 1                   4.     The system of claim 3, wherein copy operations are synchronous,  
2 said first data center updating contents of storage from contents of a cache memory prior  
3 to being reconfigured to as a secondary (target) in said second copy operation.
- 1                   5.     The system of claim 2, wherein said information fetched from said  
2 directory server comprises proximity information for a source of said input received via  
3 said at least one of a plurality of access gateways, and wherein said first data center is

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4 configured as a primary (source) of data, and said second data center is configured as a  
5 secondary (target) of data in said copy operation based upon said proximity information.

1 6. The system of claim 2, wherein said plurality of data centers  
2 further comprises a third data center, said third data center being configured as another  
3 secondary (target) of data in a copy operation.

1 7. The system of claim 1, further comprising a network interface that  
2 provides connection between at least one of a plurality of access gateways and a user  
3 terminal.

1 8. The system of claim 1, wherein information associated with a  
2 virtual volume is stored in a plurality of real volumes in said storage system.

1 9. The system of claim 8, wherein a correspondence between said  
2 virtual volume and said plurality of real volumes in said storage system is stored in said  
3 directory server.

1 10. The system of claim 1, wherein a storage volume from said first  
2 data center and a storage volume from said second data center comprise a copy volume  
3 group.

1 11. The system of claim 1, said directory server further comprising a  
2 log in process and a virtual volume information.

1 12. The system of claim 1, said host server further comprising a copy  
2 volume group interface process, a read request issue process, and a write request issue  
3 process.

1 13. A method, comprising:  
2 receiving a virtual volume name and network interface ID for a user;  
3 finding a virtual volume corresponding to said virtual volume name and  
4 network interface ID;  
5 selecting a real volume information corresponding to a data center to  
6 which said user is logged into;  
7 determining whether said data center is primary;

8           if said data center does not contain a primary volume, issuing a request to  
9   change a volume within said data center to a primary volume, waiting for a response to  
10   said request, re-setting a current primary volume, and setting said volume within said data  
11   center to be primary; and  
12           returning a real volume information for said volume within said data  
13   center set to primary.

1           14.   A method, comprising:  
2           receiving a request comprising a real volume address and a storage system  
3   address;  
4           finding a copy volume group corresponding to said real volume address  
5   and said storage system address of said request;  
6           finding a copy volume that is a current primary volume;  
7           determining whether transfer type is synchronous;  
8           if said transfer type is synchronous, then requesting that said current  
9   primary volume synchronize cache, and waiting for a response;  
10          issuing a request to change primary real volume;  
11          waiting for a response to said request;  
12          re-setting an indication that said current primary volume is primary;  
13          setting an indication that said real volume address and said storage system  
14   address of said request are now primary; and  
15          notifying of completion.

1           15.   A method, comprising:  
2           receiving write data;  
3           storing said write data in cache memory;  
4           determining whether a transfer type associated with said write data is  
5   synchronous;  
6           if said transfer type is synchronous, then sending write data to secondary  
7   volume, and waiting for response; and  
8           providing notification of completion.

1           16.   The method of claim 15,  
2           further comprising:

3 finding a copy volume group information, including a real volume address  
4 specified along with said write data.

1 17. A method, comprising:  
2 determining whether write data is stored in cache memory;  
3 if write data is not stored in cache memory, waiting and then performing  
4 determining whether write data is stored in cache memory again;  
5 finding copy volume group information for a storage system for said write  
6 data;  
7 sending said write data to said storage system;  
8 determining if said write data is to be sent to another storage system;  
9 if said write data is to be sent to another storage system, then performing  
10 said finding, sending and determining again until all write data has been sent; and  
11 notifying of completion.

1 18. The method of claim 17,  
2 wherein said copy volume group information includes a real volume  
3 address of a corresponding real volume.

1 19. An apparatus, comprising:  
2 at least one of a plurality of storage devices; and  
3 a storage control unit, comprising:  
4 a cache memory;  
5 a copy volume group information;  
6 a copy volume group definition process means;  
7 a read request execution process means;  
8 a write request execution process means;  
9 a write data send process means; and  
10 a write data receive process means.

1 20. The apparatus of claim 19,  
2 wherein said write request execution process means is operative to:  
3 receive write data;  
4 store said write data in cache memory;

5                   determine whether a transfer type associated with said write data is  
6   synchronous;  
7                   if said transfer type is synchronous, then send write data to secondary  
8   volume, and wait for response; and  
9                   provide notification of completion.

1                   21.    The apparatus of claim 19,  
2                   wherein said write data send process means is operative to:  
3                   determine whether write data is stored in cache memory;  
4                   if write data is not stored in cache memory, wait and then perform  
5   determining whether write data is stored in cache memory again;  
6                   find copy volume group information for a storage system for said write  
7   data;  
8                   send said write data to said storage system;  
9                   determine if said write data is to be sent to another storage system;  
10                  if said write data is to be sent to another storage system, then perform said  
11   finding, sending and determining again until all write data has been sent; and  
12                  provide notification of completion.

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